LAND USE PLANNING FOR ENERGY CONSERVATION

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LAND USE PLANNING FOR ENERGY CONSERVATION

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1. INTRODUCTION

Ontario's long range energy security has become a major issue. Over the past decade we have been through two energy "crises" where the very viability of our economy has been threatened. These crises were essentially related to the supply of oil, vital to our industrial society.

While oil supplies are currently plentiful, future oil disruptions are still possible. As well, other forms of energy which rely upon non-renewable resources must be conserved to ensure an energy secure future.

Past experience has shown that there is no single solution to the energy problem. This report deals with one of the important ways in which energy can be saved – through energy efficient land use planning.

The great expansion of our urban areas in the post war years was based on cheap energy. This resulted in sprawling development with most new housing built at low densities. This trend can no longer continue and energy consideration must become a major factor in future urban planning.

Land use planning techniques can be used to conserve energy in two ways: by reducing transportation needs and through reduced requirements for space heating. This report describes the various planning techniques that can be used to develop energy efficient communities and the various legislative instruments available through which these techniques can be implemented.

Ontario's municipalities will likely continue to experience slow growth rates for the forseeable future. This means that every opportunity to implement energy conserving planning techniques must be taken advantage of both for new development and for retro-fitting existing areas.

Energy conservation is only one issue that must be considered in producing an overall plan for a community. In some cases energy considerations may conflict with other objectives. For example, encouraging home occupation and local services within

neighbourhoods to reduce car travel may, on the other hand, cause some nuisance to the residents. In such cases a careful evaluation of the various options must be made to determine the trade-offs involved, which objective is more important, or if a compromise solution is possible.

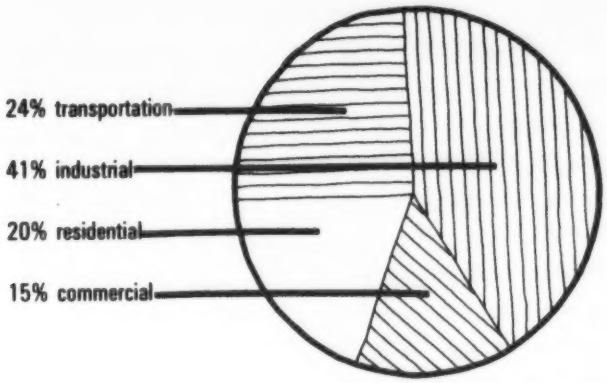
All of the techniques described in this report have been chosen because they are cost-effective energy savers and can be implemented under existing Ontario legislation.

The last section of this report contains an annotated bibliography of relevant reports and publications dealing with various aspects of energy conservation and land use planning. These publications have been selected to complement and expand upon the contents of this report for those interested in pursuing specific aspects of energy conserving planning in greater detail. For the most part, they are easily understood and readily available.

Energy efficient planning is a worthwhile objective. Making our communities more energy efficient will make them better communities.

2. ONTARIO'S ENERGY FUTURE

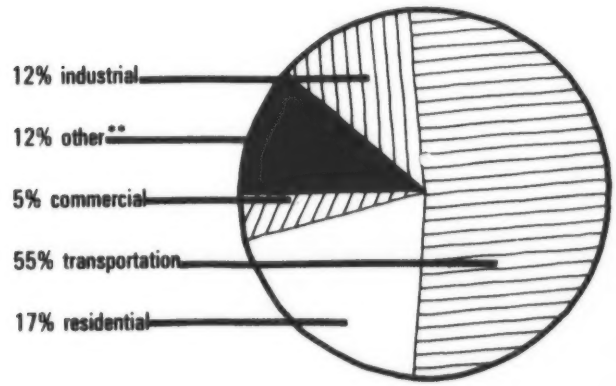
Ontario's overall energy consumption breaks down as follows:*



Overall energy consumption by sector

Transportation and residential uses, the areas where land use planning can be most effective in energy conservation, account for 44% of total energy consumption. There is, therefore, considerable scope for energy conservation through land use planning techniques.

As pointed out in the Introduction, our energy problems stem largely from the uncertainty of foreign oil supplies. The importance of oil in the energy picture can be seen when its consumption by sector is examined.



Consumption of oil by sector

*For a fuller discussion of Ontario's energy future see: "Ontario Energy Review," Ontario Ministry of Energy, September, 1983.

**Primarily Petrochemicals

The transportation and residential sectors account for over 70% of the oil consumed in Ontario.

Crude oil currently supplies approximately 35% of Ontario's primary energy needs. Practically all of this is imported from other provinces or countries. It is the aim of the Ontario government to reduce the proportion of oil as a primary energy source to 25% by the year 2000.

Other energy sources

Ontario itself produces only 25% of the primary energy which it consumes. This is mainly electrical power produced by hydraulic and nuclear generating stations. The energy that we import, besides oil, is mainly in the form of coal and natural gas. While the supply of these fuels is relatively plentiful and secure, their importation is nevertheless a drain on the provincial economy and their conservation as well makes economic sense.

Public confusion

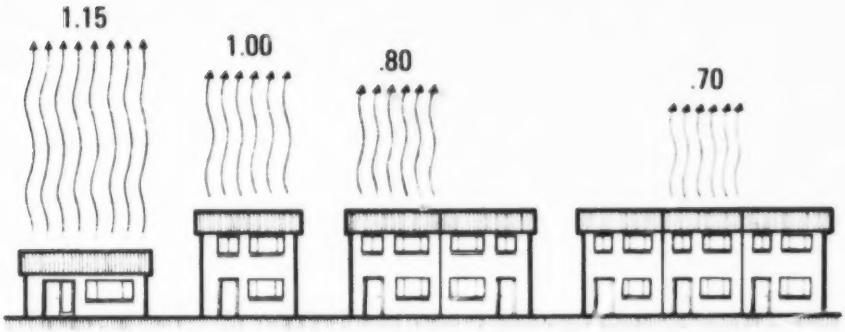
Because of the cyclical nature of the energy supply picture and the proliferation of reports, articles and announcements emanating from various public and private sources, the general public is understandably confused about the real nature of the energy problem. However, temporary periods of oil surpluses are no time to let up in our attempts at energy conservation. During energy secure periods we have an opportunity to rationally deal with long term energy conservation goals outside of a crisis atmosphere. By utilizing the techniques described in this report a major contribution can be made towards Ontario's goal of an energy secure future.

3. BASIC PRINCIPLES

This chapter describes the basic planning principles which can be utilized now to make our communities more energy efficient.

HIGHER DENSITIES

Of all the energy conserving techniques available to planners, increasing densities is the most effective. Increasing residential densities, particularly if multiple family units are included, will result in a considerable reduction in both space heating needs and transportation energy requirements.

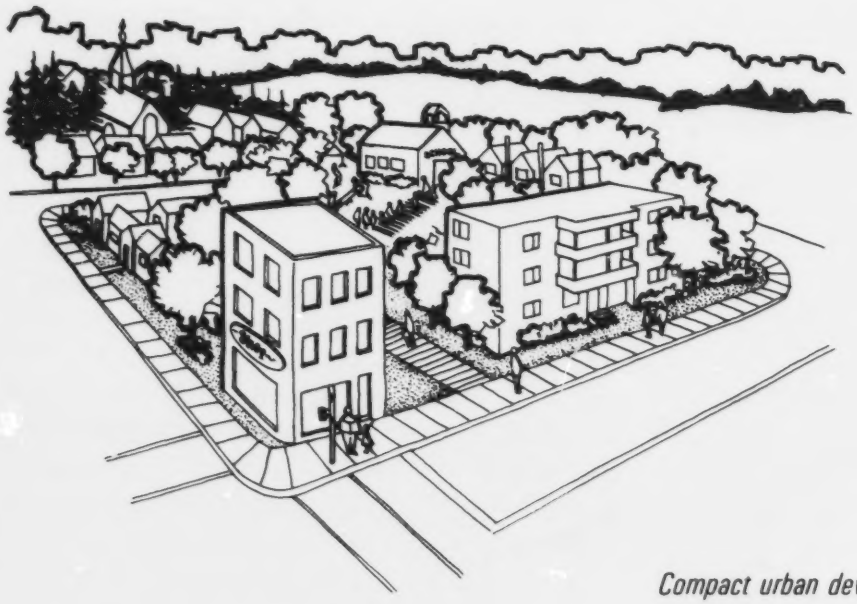


Heat losses are partly a function of floor area ratio and the number of common walls

The single storey detached bungalow is the most inefficient form of housing consuming 15% more energy than a two-storey house of the same floor area. The inside unit of a row house group consumes only 70% of the amount of energy of a two-storey detached house. Apartment units require only 25% as much energy as a detached house. Multiple family units are more energy efficient because less wall area is exposed to the outside.*

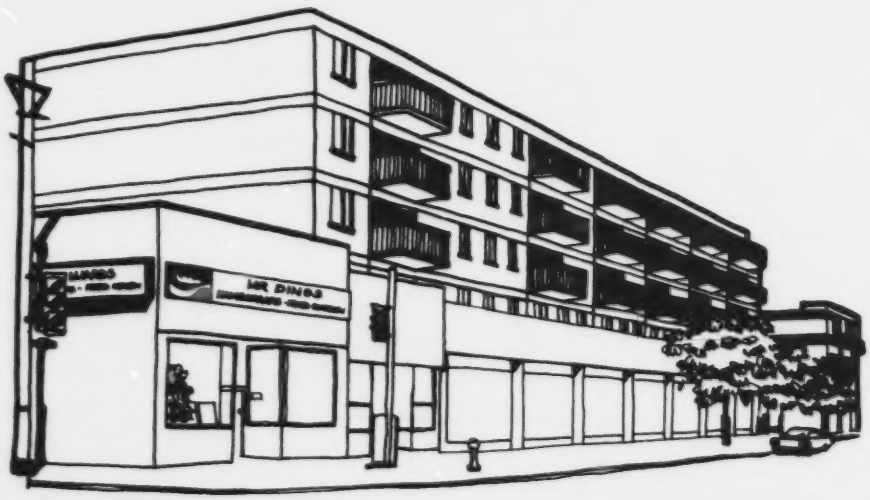
Increasing densities in all types of uses will result in reduced travelling distances for shopping, work and personal service trips, thus directly reducing our consumption of oil.

*For a discussion of the energy conserving aspect of multiple family housing see: "Site Planning Guidelines for Medium Density Housing," Ontario Ministry of Housing, January, 1980.



Compact urban development

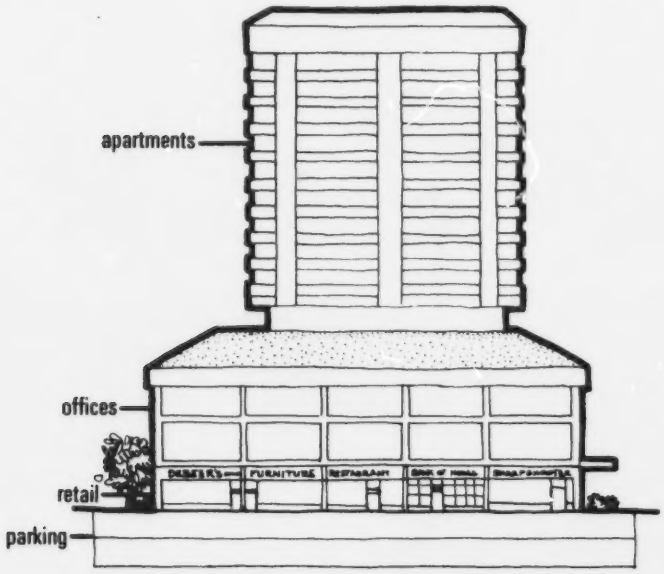
Infilling, often with multiple family units, is another way of increasing overall community densities and improving energy efficiency.



Residential infill development

MIXED USE BUILDINGS

Mixed use buildings which contain a variety of uses can result in reduced transportation needs. Typically, these buildings contain a mixture of residential, commercial and office uses. Thus a person can theoretically live, work and consume services all in one location.



Mixed use building combining multiple uses

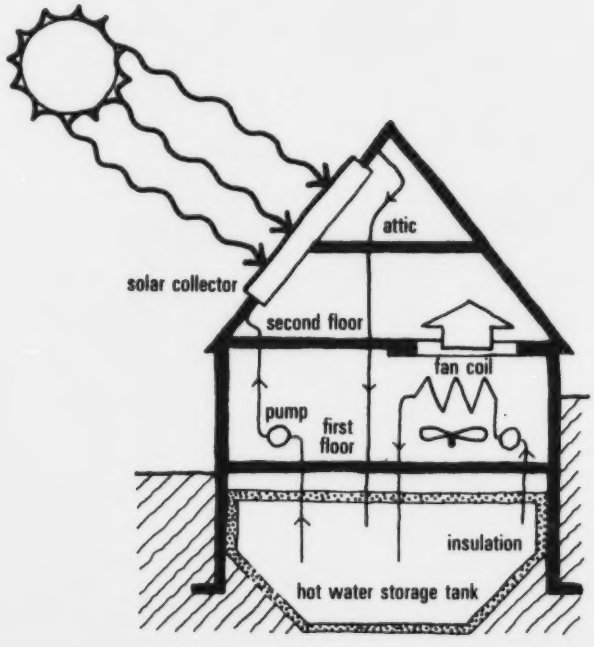
There are various other combinations of uses possible. For example, the office and apartment units could be contained in separate towers and the commercial area could be underground. But whatever the combination or arrangement of uses, these buildings will result in reduced energy demands.

SOLAR ORIENTATION

In recent years a great amount of attention has been focused on the use of solar energy for space heating.* There are two types of solar heating techniques – active and passive.

*The basic principles of energy efficient subdivison design are outlined more fully in: "Handbook for Energy Efficient Residential Subdivision Planning – Overview," Ontario Ministry of Municipal Affairs and Housing, February, 1982.

Active systems utilize solar radiation collection and storage devices to provide heat over long time periods.



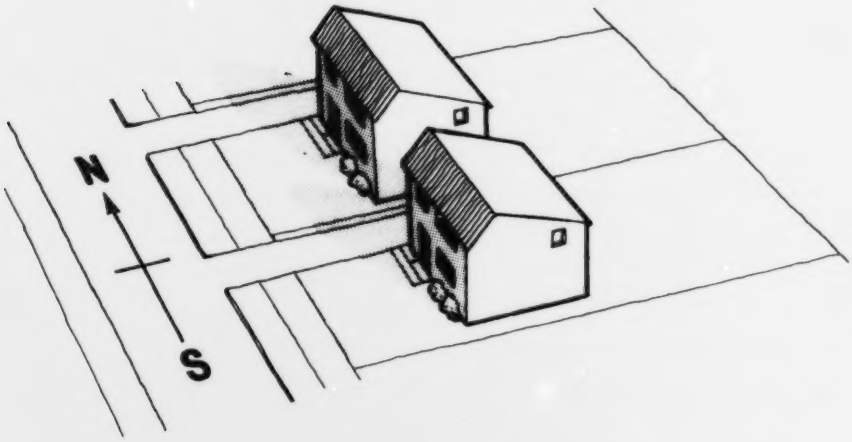
Active hot water solar heating system

Passive solar systems utilize the radiation of sun on the windows and walls of a house to warm it during periods of sunshine.

East-west street pattern is most appropriate for purposes of passive solar heating

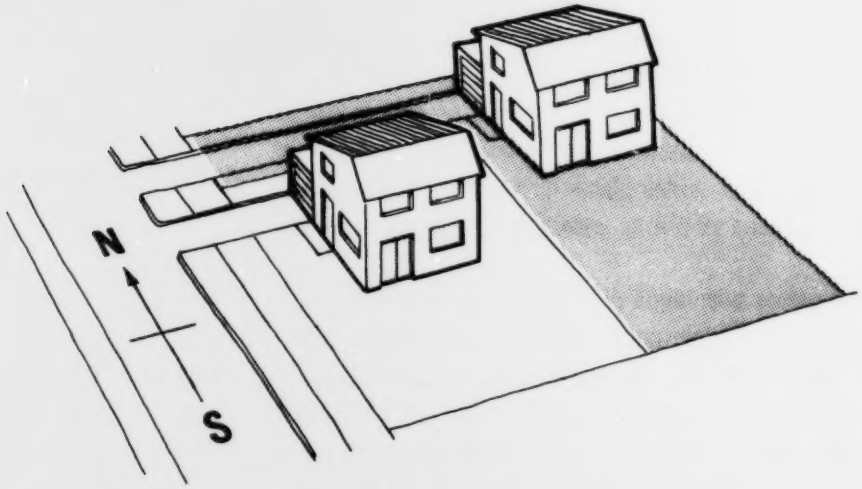
Active solar systems have not proven to be cost-effective in our climate and suffer from maintenance problems because of their complexity. However, in the future, some of the technical problems may be overcome thus making these systems more practical.

Both active and passive solar systems rely on proper orientation of streets, lots and houses to southern exposures.

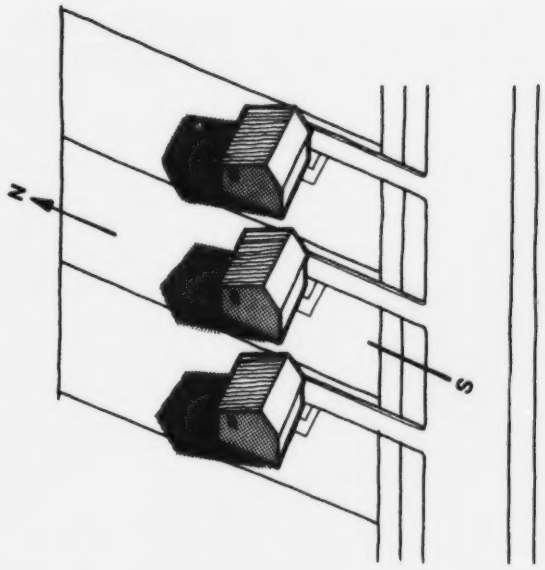


North-south layout of streets limits reception of solar radiation

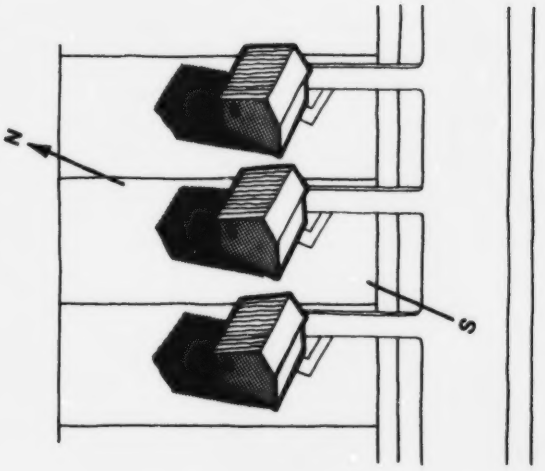
A basic east-west street alignment is the best for maximizing solar access to south facing walls of buildings. However, not all streets in a development can, nor should, be aligned east-west. For those lots and houses not on east-west oriented streets, other solutions are available.



Use of key lot provides for south orientation



Angled lots improve south orientation



Houses can also be angled to improve solar access

The proper orientation of homes to the sun is, of course, also important if an active solar system is to be installed at the time of construction or at a future date.

TRANSPORTATION

Transportation is highly dependent on oil and therefore conservation in this sector is extremely important. In addition, transportation patterns and distances are closely related to land use patterns. There is, therefore, considerable scope for land use planners to effect energy conservation through reduced transportation requirements.

Public transit

Public transit is very energy efficient and provides an essential service to the community as well. Public transit can only be cost-effective, however, if densities in communities are sufficiently high to attract enough ridership. Transit systems at the same time must offer an attractive and convenient alternative to the private automobile to be competitive.

Higher density location

As a basic principle, higher density uses should be located along major transportation facilities (roads or rail line) to maximize public transit efficiency.

Higher densities will also reduce transportation distances for individual automobile trips. Proper traffic management can also reduce travel times and stop and go situations thereby further reducing energy needs.

Interrelationships of land use and transportation planning

Practically all land use planning decisions will have an impact on transportation systems. The interrelationship between land use planning and transportation planning is highly complex. Therefore, most planning decisions should include an analysis of their effects on the transportation systems of the community. Wherever appropriate, actions which would enhance transportation energy efficiency should be considered.

INTENSIFICATION OF EXISTING FACILITIES

The majority of our urban areas are already in place so that to take full advantage of energy conservation possibilities, developed areas must also be examined to determine any energy saving possibilities.

Convenience services in neighbourhoods

Many existing neighbourhoods, particularly those developed in the 50's and 60's, are built at low densities with convenience services concentrated in shopping centres. Many of the more basic services

concentrated in shopping centres could be integrated in these neighbourhoods thus reducing automobile trips.

Most suburban low density developments contain a great number of houses with four or five bedrooms. With the trend toward smaller families, many of these homes are under-utitlized. Where appropriate, provisions could be made to permit multiple family use of these dwellings under proper guidelines.

Conversion of single family homes

During the suburban construction boom, many small shopping centres were built which are now obsolete. Their location on major transportation routes makes them ideal for reconstruction to higher densities and multiple use. Multiple family redevelopment with mixed commercial and office uses would make them very energy efficient developments.

The existing neighbourhoods in the older parts of our cities tend to be built at higher densities with more service facilities within walking distance. However, here too, infill development and more non-obtrusive service facilities can be integrated into the existing neighbourhood provided proper safeguards are taken.

Infill of existing neighbourhoods

In considering intensification of existing uses, services such as roads, sewers, water, etc. must be adequate to support the more intensive land uses.

Adequate services

4. PLANNING TECHNIQUES

The Planning Act, 1983

The Planning Act provides the basic framework within which a municipality can implement energy conservation through land use planning. Under the Planning Act, municipalities are authorized to produce official plans which provide general statements on the goals and objectives of the municipality. The municipality is also authorized to produce a zoning by-law which implements the land use control aspects of the official plan. In addition to these two instruments, a municipality can achieve its planning goals through the subdivision and site plan control processes.

OFFICIAL PLANS

Section 17* of the Planning Act allows a municipality to prepare and adopt an official plan. Official plans form the basis under which most municipal planning decisions are made.

Since an official plan is the "umbrella" under which a municipality undertakes planning decisions, it is the appropriate place for a municipality to state its energy conservation policies, goals and objectives as they relate to the planning of the community.

Because of the great variation in the size and nature of municipalities in Ontario, it is not possible to specify the specific energy conservation measures which should be placed in an official plan. As a general principle, the official plan should encompass all of the various types of energy conservation measures which a municipality might realistically undertake through its planning process.

POLICY STATEMENTS

An energy policy statement can form an important part of the official plan. It can indicate the municipality's commitment to energy conservation and provide the basic framework and principles for specific policies in the official plan.

Content

The precise form and context of energy policy statements will depend on the organization of the

*More detailed information is contained in "Energy Conservation Through Official Plans – A Guideline," Ontario Ministry of Municipal Affairs and Housing, February, 1982.

plan, local attitudes and circumstances. Generally, the policy statement should provide an overview of the types of future actions which the municipality will undertake in achieving energy efficiency through land use planning, and set the stage for more specific activities in the plan.

OFFICIAL PLAN POLICIES

The basic principles of land use planning for energy conservation were outlined in the previous chapter. Those which apply to official plans are:

Increased Densities

- provide for higher densities for all land use categories
- locate higher densities along transportation corridors and in nodes to support public transit
- ensure that areas designated for future development are adjacent to existing developed areas and that development takes place in a logical manner

Intensification of Existing Areas

- allow redevelopment of underutilized areas and buildings at greater densities
- provide for the infilling of vacant lots and the unused portions of large lots in central locations
- permit the conversion of existing buildings to more intensive uses (e.g., conversion of large single family homes into multi-family, conversion from warehousing to office use in strategic location, conversion from single to multiple uses)

Integration of Uses

- provide for mixed use buildings and areas to bring complementary uses together
- allow complementary or service type uses within basic land use designations (e.g., convenience shopping in residential and industrial areas, home occupations)
- allow residential uses close to place of work (e.g., office, industry)
- provide for a range of recreational opportunities in close proximity to other uses
- provide for "service nodes" of commercial, institutional and government activities to allow for convenient non-vehicular movement between buildings

NEIGHBOURHOOD AND SECONDARY PLANS

While the official plan deals with broad land use issues, a municipality may also undertake a more detailed planning exercise at the neighbourhood level or any sub-area level of a municipality. Neighbourhood plans are useful in more clearly defining specific policies and offer a more concrete and smaller scale plan for public discussion. It is also at the neighbourhood plan scale that trade-off situations become more obvious.

Energy conservation policies

The following are the areas which can be addressed at the neighbourhood plan level:

- establish the type and density of residential development and its location in more detail
- establish the relationship of residential development to community and commercial facilities, main traffic arteries and public transportation
- designate as much multiple-unit or attached housing as reasonable
- designate higher densities near major transit routes
- designate neighbourhood level services and facilities in convenient locations
- minimize street length to achieve energy savings in material and by reduced trip lengths
- provide for road alignments that enable lot orientations which maximize solar access
- provide convenient access to transit stops
- provide for convenient pedestrian and bicycle routes through neighbourhoods to local facilities

Trade-offs

Some important trade-off situations become obvious at the neighbourhood level. First, including large amounts of multiple family housing is in contradiction with the general planning principle of offering a wide range of housing types and location to ensure maximum choice for residents. For example, the single family house is still the most desired form of accommodation. However, it is also the most energy inefficient form of housing. Simply designating multiple family housing will not ensure that it will be built or occupied. Therefore, muinicipalities must carefully weigh just how much multiple family housing is acceptable.

Another major conflict arises in making road systems more efficient traffic handlers. This often can increase volume and speed of traffic. Most residents of neighbourhoods desire less traffic and lower speeds through their areas. Again, careful consideration of just how far to go with such proposals must be made.

Increasing neighbourhood level services can also cause conflicts if the uses are intrusive. Most neighbourhood residents want stability in their areas and any non-residential uses must be carefully thought out and adequately controlled to ensure they do not become nuisances.

Environmental concerns

Integration of uses such as industrial and residential can raise environmental concerns. These must be dealt with at the early planning stages to ensure that the different uses can co-exist.

ZONING

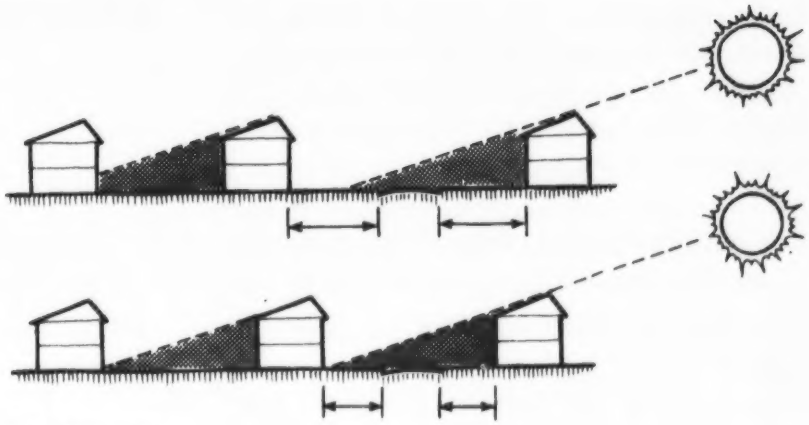
Zoning is a powerful tool which can be used directly to carry out energy conservation measures. Section 34 of the Planning Act describes the powers available to a municipality through the zoning process. Among the most significant powers available to a municipality through zoning are:

Types of controls

- the regulation of the density of development and the mixture of land uses
- the type of construction and the bulk, height, size, floor area, spacing, character and use of buildings
- the minimum frontage and depth of a parcel of land and the proportion of the area that a building may occupy

By controlling the density of development and the mixture of land uses, a municipality can ensure that new developments take advantage of energy efficient housing types and mixed use building forms.

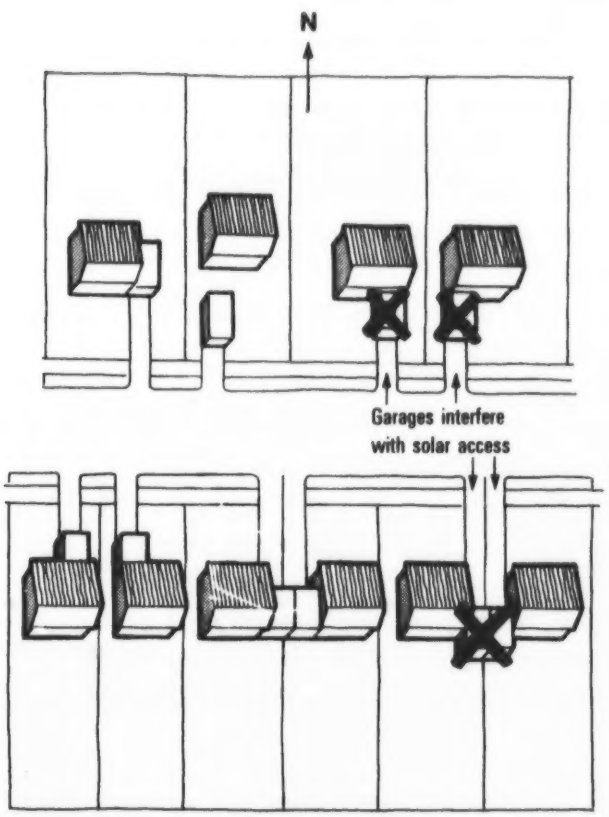
Another important use of zoning is in regulating building height, location and to assure that all units have maximum solar exposure.



Reduction in front yard setbacks may improve solar access possibilities

Other ways in which zoning by-laws can be used to maximize solar gains are:

- **regulating the location of above ground garages and other accessing structures to avoid shading**



Garage placement should not result in shadows falling on south wall of house

Home occupations

Another important area where zoning can directly effect energy conservation is in permitting home occupation and local services within residential districts. Some types of uses which may be permitted in residential neighbourhoods are:

- the office of professions and consulting businesses
- tradesmen and contractors
- real estate and insurance agencies
- small scale manufacturing and repairs of small articles such as toys, furniture, electrical appliances, etc.
- workshops for tailors, hairdressers or barbers
- small convenience variety stores

Site specific controls

In permitting such uses, consideration must be made to ensure that they do not become disruptive or a nuisance. It is therefore best that any such changes should require rezoning to allow for site specific controls. The types of controls that should be considered include:

- restriction to a secondary use only of a dwelling
- restrictions on floor area
- ensure that the uses do not become a nuisance with regard to noise, pollution, vibration, traffic or parking
- ensure that no fire, health or building hazard occurs
- a limit to the number of pesons employed in the premises

Bonusing

Finally, Section 36 of the Planning Act allows a municipality to increase height and density of a development to over that otherwise permitted in return for the provision of facilities or services which may benefit the community. This "bonusing"* provision could be used to encourage developers to include energy conserving features in their developments.

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* For further information see Planning Act "Guideline 8 – Zoning and Other Land Use Controls," Oct. 1983, Ministry of Municipal Affairs and Housing.

SITE PLAN CONTROL

Under Section 40* of the Planning Act, a council can designate the whole or any part of a municipality as a site plan control area. Where site plan control is in effect, a municipality has a wide range of powers to control the form of development on a specific site. Basic to this feature is the control of the location of all buildings and structures to be erected on a site. Some of the other powers available include:**

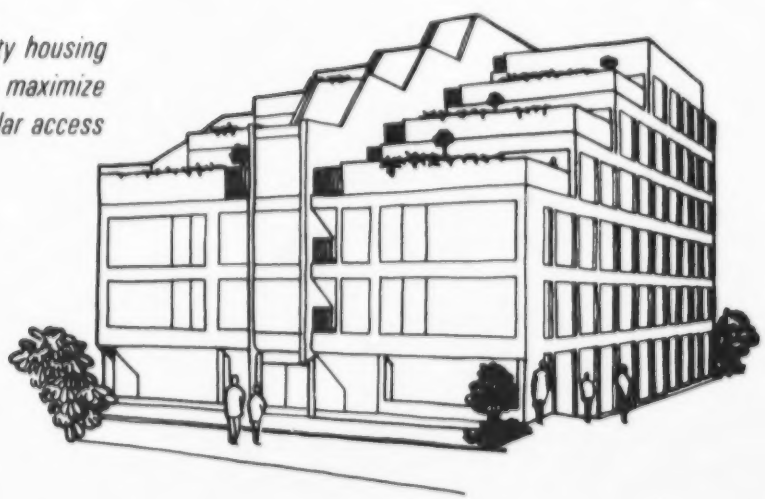
Powers available under site plan control

- the provision of drawings showing the plan elevation and cross-section of each building to be erected
- the massing and conceptual design of buildings
- the relationship of the proposed building to adjacent buildings, streets and exterior areas to which the public has access

Under these controls, the drawings could be required to show the shadows cast by the proposed development on adjacent buildings thus helping in determining their effect on the solar access of their neighbours. Height controls if desired, however, must still be established under Section 34 of the Planning Act.

Site plan control by-laws can be used to orient buildings on a lot to maximize solar gain.

Medium density housing oriented to maximize solar access



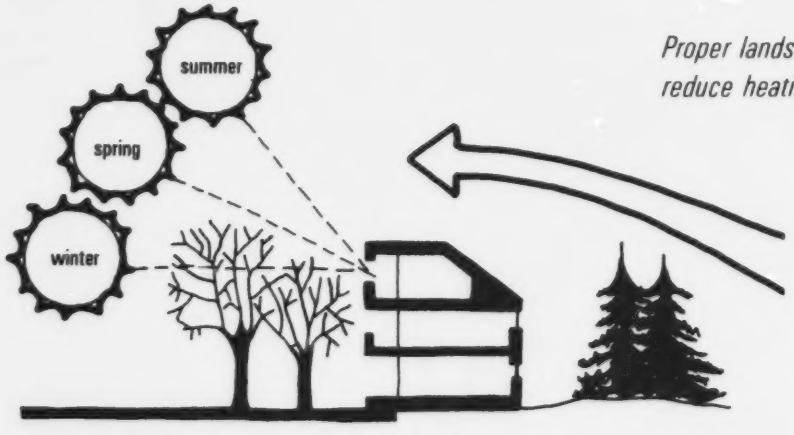
* Section 40 of the Planning Act will come into effect in late, 1985.

** Does not apply to residential buildings containing less than 25 units unless designated in the Official Plan as an area where drawings are required.

Approval of site plan control plans and drawings can be made subject to certain conditions which can be used to improve the energy efficient impact of the development on its neighbours. These provisions are contained in Section 40(7) of the Planning Act. These conditions could include:

Approval subject to conditions

- the construction of centrally located pedestrian walkways sheltered from wind by walls, fences or trees to encourage trips by foot
- the reduction or elimination of floodlighting or the use of high-efficiency external lighting systems such as high pressure sodium lamps
- the planting of coniferous trees to the north of buildings and open recreational areas to protect against northerly winds and the planting of deciduous trees to the south to provide shade in summer and solar access in winter
- the construction of berms to provide insulation and windbreaks



Proper landscaping can help reduce heating costs

SUBDIVISION CONTROL

Energy efficient subdivision design is an important factor in helping a municipality achieve its energy conservation goals. Studies previously undertaken* have shown that approximately 15-20% can be saved in space heating costs through the use of energy efficient subdivision design.

*Saving Energy By Way of Site Design – Ontario Ministry of Municipal Affairs and Housing.

Powers available under subdivision control

Subdivision control is implemented through Section 50 of the Planning Act. Among the powers a municipality has under this section is the requirement of plans showing:

- the approximate dimensions and layout of the proposed lots
- the location and widths of streets within the subdivision
- the location of natural and artificial features such as buildings, water-courses and wooded areas on or adjacent to the site
- the existing contours or elevations as required to determine the grade of streets and the drainage of the land

Among the matters to be considered in evaluating the subdivison plan is the physical layout of the plan having regard to energy conservation.

Energy conservation features

Some of the energy conserving design features which can be achieved through the subdivision process include the following:

- the orientation of streets in an east/west axis to maximize solar access
- narrower streets to reduce embodied energy for hard services*
- street patterns designed to reduce travel distances and improve public transit efficiency
- the control of the dimension and shapes of lots to make use of solar gain by maximizing the north-south orientation of lots
- the orientation of a maximum number of buildings to have the wall with the greatest window area facing south
- appropriate landscaping to provide protection from wind by requiring coniferous trees in the north to protect from northerly winds, and deciduous trees in the south to provide shade in summer but allow the sun to shine through in winter

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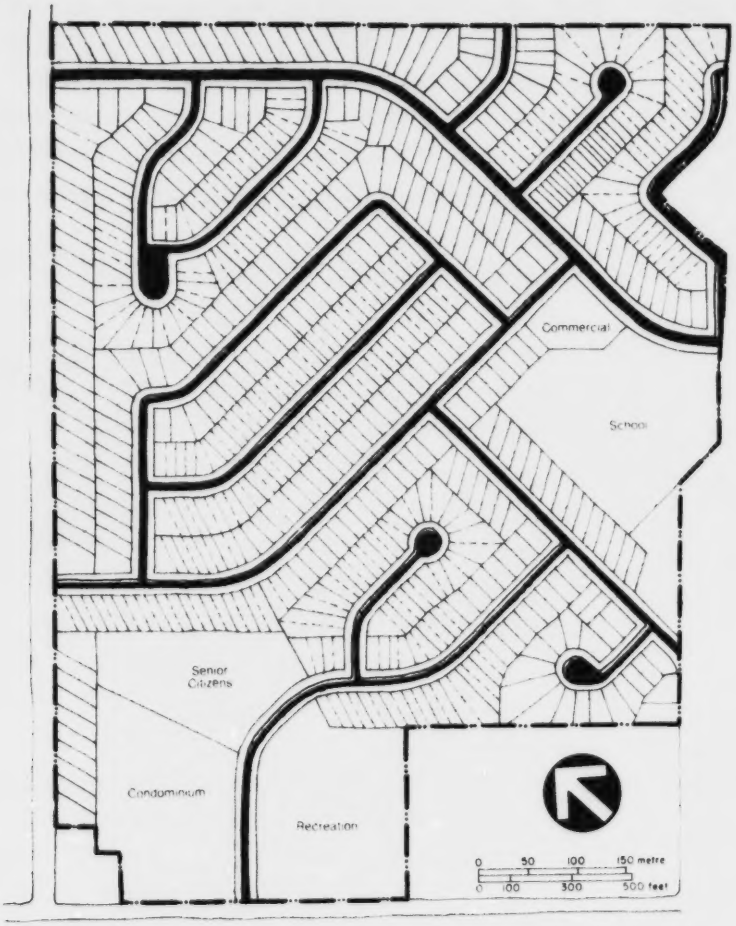
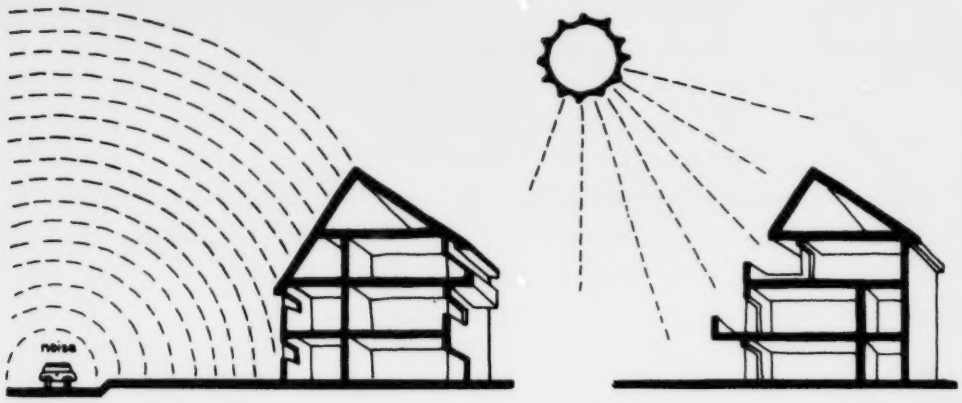
*Urban Development Standards – A Review — Ontario Ministry of Municipal Affairs and Housing, July, 1982.



An energy efficient subdivision design taking maximum advantage of southern exposure

Trade-offs

Subdivision design involves a complex set of considerations. Energy conservation is only one of these. In some cases energy conservation measures can conflict with other planning goals. For example, noise considerations for a building on the north side of an arterial would place large windows and recreational areas on the north side of the structure, away from the noise source. On the other hand, energy requirements would place them on the south side of the building.



Noise and energy considerations in conflict

Achieving an energy efficient design by orienting streets and lots for solar access can lead to high grading costs if the contours of the site are such that a great amount of earth movement must be done to "force" the design on the site. Drainage problems can also result. In these cases, a careful analysis of the costs and benefits of the design options must be made and the relevant trade-offs determined.

Landscaping can help achieve energy conservation by sheltering buildings from northerly winds and shading the south face in summer. However, landscaping is expensive and must be maintained to ensure that it functions properly and does not overgrow and become a potential sun blocker to neighbouring buildings. In general, landscaping is possibly better utilized at the larger subdivision scale rather than at the individual lot level.

To ensure solar access in a development, spacing between buildings must be adequate to ensure that overshadowing does not occur. To some extent, this may contradict the general principle of achieving higher densities.

5. OTHER TECHNIQUES

Planning measures should be combined with other techniques to maximize energy efficiency in community development. In many instances, these other techniques are compatible with planning measures.

Public transit, parking, traffic control

Public transit, parking and traffic control are integrally linked with land use planning and some of these relationships have been covered in various parts of the preceeding chapters. However, there are some actions in this field which, though not directly linked to planning, have important related energy impacts.

An overall traffic control policy for a municipality, including one way streets, reverse lane directions for rush hour traffic flows and reserved lanes for transit vehicles can improve energy efficiency. However, these actions may impact adversely on adjacent land uses and this trade-off must be considered.

Parking restrictions in core areas can be used to discourage traffic into core areas and encourage use of public transit.

Municipal energy management programs

Many municipalities have undertaken municipal energy management programs which co-ordinate the various energy conservation undertakings of the community. Such activities as municipal fleet conservation programs, public building energy audits, energy through waste heat recovery programs as well as municipal energy planning activities can be integrated through this process.

Insulation and sealing of dwellings

Adequate insulation and sealing of houses should be a major thrust of any energy conservation program. The proper insulation and sealing of houses is also important in maximizing the energy savings possible through solar oriented subdivision design.

Public participation

Finally, public participation can play an important part in achieving energy efficient planning. Many of the trade-offs and conflicts mentioned in this report can be overcome through the public participation process. Having the public involved in the development and implementation of energy efficient activities can help make them understandable and supportable. A public that is energy conscious and which is given a fair

chance to be involved in energy conservation planning can be a valuable asset in helping to achieve an energy efficient community.

6. ANNOTATED BIBLIOGRAPHY

SOLAR ACCESS

Perspectives on Access to Sunlight
Ontario Ministry of Energy – 1978

A basic guide on how to achieve solar access to buildings through various orientation, setback and height techniques. A handy guide for those seeking general information on or an introduction to this topic. Well illustrated.

Subdivisions and Sun – 3 Design Studies
Ontario Ministry of Energy
Prepared by: M.M. Dillon Ltd.; Henry Fliess and Partners, Architects; John Hix, Architect & Planner

This report presents sample residential subdivision designs undertaken by each of the above consultants to explore means by which passive solar energy can be enhanced in new developments. The examples include analysis of efficiency gained, correct solar angles and spatial requirements, street orientation techniques, proper landscaping and planting procedures and compatible house designs. All three consultants conclude that substantial solar gain can be achieved without greatly increased costs or the creation of radically different house designs or subdivision patterns.

Saving Energy by Way of Site Design
Ontario Ministry of Municipal Affairs and Housing
Project Planning Branch, April, 1981

Saving Energy by Way of Site Design is an abridged version of the General Report on Residential Site Design and Energy Conservation first published in July, 1980. This report summarizes the main findings of the original report. It illustrates possible energy savings by improving residential site designs and by selecting conventional housing sensitive to the local climate. It found that savings of up to 15 to 20 percent were possible through the use of various site planning techniques.

Handbook for Energy Efficient Residential Subdivision Planning: 1: Overview
Ontario Ministry of Municipal Affairs and Housing
Project Planning Branch, February, 1982

This is the first in a series of reports to be issued in the form of a Handbook dealing with energy efficient residential design. The Overview report outlines the basic principles of energy efficient subdivision design.

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Ontario Ministry of Muncipal Affairs and Housing
Project Planning Branch, May, 1982

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PLANNING LEGISLATION AND ENERGY CONSERVATION, ONTARIO

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Ontario Ministry of Municipal Affairs and Housing
Operations Control Branch, February, 1982

An outline of the various planning techniques which can be included in official plans to conserve energy. Topics covered include, among others: compact developed areas, land use mix and spatial relationships, neighbourhood planning, development applications, reuse of existing building, retrofit, renovation, transportation and energy distribution systems.

PLANNING AND ENERGY CONSERVATION – GENERAL

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Ontario Ministry of Energy, June, 1980

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Energy Conservation Choices for the City of Portland, Oregon
City of Portland
Bureau of Planning, 1979

A comprehensive analysis of the many approaches a municipality can take towards energy conservation published in 11 volumes. The most significant one for

planners is Volume 3B, "Transportation and Land Use Conservation Choices," which develops choices available to the city for conserving energy through transportation and land use programs. The report is designed so that the planning methods developed can be used by other cities.

Energy-Efficient Community Planning – A Guide to Saving Energy and Producing Power at the Local Level
James Ridgeway, The J.A. Press, Inc.

An examination of the techniques used by Seattle, Washington and Davis, California, to conserve energy and develop energy-efficient new developments. Some of the techniques employed by Davis, California are particularly innovative although, to some extent, restricted to cities with relatively mild climates.

Energy Conservation in Land Use Planning
City of Brampton, February, 1979

A basic description of the types of planning techniques that a medium-sized, growing municipality can use to achieve energy conservation. Some of the techniques described include the use of higher densities, mixed use developments, east-west orientation of streets and solar access guarantees through zoning and restrictive covenants.

City of Woodstock Energy Policy Development Study
Ontario Ministry of Energy
Prepared by Henry Fliess and Partners, Architects, 1981

This study investigates those aspects of planning and planning legislation that can be modified to improve the energy performance of a community. The existing by-law provisons were reviewed and recommendations for changes made. Solar access planning opportunities are outlined and legislative methods suggested. The role of density, transportation and landscape screening in energy conservation are assessed. Energy conservation strategies such as earth shelters, windmills, solar collectors and woodburning are commented on.

Put Energy in Your Planning: A How-to Guide for Community Planners
American Institute of Planners, Chicago, Ill., 1976

A checklist for planners interested in including energy in their planning programs. Extremely comprehensive.

Site Planning Guidelines for Medium Density Housing
Ontario Ministry of Housing
Local Planning Policy Branch, January, 1980

A comprehensive examination of site planning requirements for medium density housing. It includes a section on energy conservation and some of the trade-offs which have to be considered between conflicting land use principles.

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Ontario Ministry of Municipal Affairs and Housing, June, 1982
Local Planning Policy Branch, June, 1982

This report indicates, among other things, how reduced servicing standards can save embodied energy for such items as sewers, roads, sidewalks etc.

Ontario Energy Review
Ontario Ministry of Energy, September, 1983

A review of the energy picture in Ontario with data on energy consumption, energy distribution by sector and type and predictions of Ontario's energy future and goals. A guide to the energy policies of the provincial government.

Energy Handbook for Planners – Executive Summary
Ontario Ministry of Energy, July, 1983

The Summary outlines the contents of a series of 10 reports covering a wide range of planning related energy conservation topics. The Handbook components are:

- Glossary of Energy Terms for Planners
- Solar Energy and Land Use

- Solar Zoning Techniques
- Energy and Rural Land Use Planning in Ontario
- Landscape Planning for Energy Efficiency
- Climatic Information for Energy Conscious Planning
- The Community Energy Profile: Concepts, Methods, Applications
- Guide to Community Energy Profiling
- Estimating Energy Consumption for New Development
- Alternative Energy Supplies and Technologies and their Implications on Land Use Planning.

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